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Presolution and postsolution nonreversal shifts with varying levels of stimulus redundancy in a concept identification task.

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PRESOLUTION AND POSTSOLUTION NONREVERSAL SHIFTS WITH VARYING LEVELS OF STIMULUS REDUNDANCY IN A CONCEPT IDENTIFICATION TASK

A Thesis Presented

By

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ABSTRACT

The purpose of the experiment was to see whether level of preshift learning affected postshift learning differentially and what the effects of varying redundancy would be in each of these groups. 72 introductory psychology students solved a concept identification task. Two groups of 18 subjects underwent a nonreversal shift either prior to or after solution of an original task. Data from an additional 36 subjects originally in the presolution shift group but who showed correct transfer over blank trials, were removed from the main analysis. All subjects received a ten trial stage immediately prior to the shift during which the relevant and to-be-relevant dimensions were either 50%, 75% or 100% redundant.

The results show that a nonreversal shift after the complete solution of an original task produces postshift performance inferior to that of presolution shift groups. Subjects in the 100% redundant groups were found to do significantly better than subjects in the partially redundant groups. It was concluded that presolution-shift learning is affected by redundancy in much the same way as postsolution-shift learning. An analysis of preshift learning of those subjects whose data were removed from the main analysis showed transfer to be optimal in the 75% redundant group. The above results are explained in terms of misinformative feedback and its effects on the use of short-term memory.

INTRODUCTION

A concept identification task requires the subject to classify or group together a number of stimuli on the basis of a common characteristic and to label them with the same response. If the subject can identify what characteristic makes the stimulus a member of the class he will be able to make a correct response to that stimulus. The stimuli in such a task vary in a number of ways called dimensions, such as size or color. Each dimension can take on two or more values, such as, in the case of size, large and small. The dimensions which provide the basis for correct responding are referred to as the relevant dimensions. All other dimensions are irrelevant to the solution of the task. The present experiment involved a simple concept learning task in which a single dimension defined the solution.

Learning of the concept is assumed to have taken place when the subject responds correctly to a number of consecutive stimuli. The criterion run is usually ten or fifteen trials long. When two of these tasks are run one after the other with no break in timing and no announcement or warning given to the subject, a study can be made of the ease or difficulty involved in shifting solutions. One type of solution shift, a nonreversal shift, is defined by shifting the basis of solution from the previously relevant dimension to a formerly irrelevant dimension.

The number of dimensions being used has a direct effect on task difficulty for it determines the size of the stimulus set.

With N bi-valued dimensions there are 2^N different stimuli. Walker & Bourne (1961) found that task difficulty increased with an increase in the number of irrelevant dimensions. Given a constant number of dimensions, one way to reduce the size of the stimulus set is to make one stimulus dimension redundant with another. In the case of relevant stimulus redundancy, the redundant dimension is made to covary with the dimension which is relevant to solution. The amount of this covariance between dimensions affects the degree of predictability of one dimension given that the other is known.

The present experiment involved the use of a nonreversal shift in a concept identification task where some degree of stimulus redundancy had occurred between the dimension which was relevant to problem solution prior to the shift and the dimension which would be relevant after the shift. A comparison was made to determine the effects of shifting the problem solution prior to or after the subject had solved the initial task. A second question was whether different amounts of redundancy between the relevant and the to-be-relevant dimension had different effects on the postshift learning rate in either of these two paradigms.

In a recent experiment Guy, Van Fleet & Bourne (1966) studied the effect on nonreversal shift learning of varying the amount of redundancy between the relevant and to-be-relevant dimensions during an intermediate stage. All subjects were required to solve a simple concept identification task with five dimensions. Then a novel dimension was added for either ten or twenty trials, which was either 50, 75, or 100% redundant with the relevant dimension. In the final stage of the experiment a nonreversal shift occurred making the newly added and redundant dimension the sole relevant dimension.

The results indicated that subjects exposed to any amount of redundancy for any number of trials showed slower postshift learning than control subjects who underwent the nonreversal shift to the novel dimension immediately after the completion of the first task. Amount of redundancy also affected postshift learning which occurred significantly earlier and with significantly fewer errors for the 100% redundant group than for the 75% redundant group; and the 75% redundant group took significantly fewer trials and had significantly fewer errors than did the 50% redundant group.

Guy et.al. (1966) interpreted these findings as inconsistent with the literal interpretations of both hypothesis testing and cue conditioning theories of concept identification. The unexpected finding that postshift learning was actually retarded by all percentages of preshift redundancy between the relevant and to-be-relevant dimensions was interpreted as being inconsistent with cue conditioning theories. The findings interpreted as being inconsistent with the hypothesis testing theories were: first; the interfering effect produced by the intermediate stage; second that this interference was inversely related to the amount of redundancy between the dimensions; and third, that this effect was more pronounced with an increase in the number of trials of the intermediate stage. The one finding interpreted as being consistent with hypothesis testing theories was the facilitating effect of shifting solutions immediately upon introduction of the novel dimension. This is because a novel dimension is a highly salient one and therefore the hypothesis that this cue will lead to correct responding, has a high probability of being sampled.

The Guy et.al. (1966) study has shown that redundancy in an intermediate stage has interfering effects and that increasing the percentage of redundancy tends to decrease the severity of the interference. However, the role of stimulus redundancy in concept identification tasks has, in the past, been found to be facilitative. Bourne & Haygood (1959, 1961) found redundancy between relevant stimulus dimensions improved performance; this facilitation was more apparent with an increasing number of irrelevant dimensions. Redundancy between irrelevant dimensions reduced the interference of the irrelevant dimensions. In general agreement with Guy et.al. (1966) are the results of Bourne & Haygood's (1960) study in which a nonreversal shift was employed in the second stage of the experiment after various percentages of redundancy between dimensions had been used in the first stage. They found that increasing the amount of redundancy prior to the nonreversal shift decreases the amount of interference after the shift.

In the present experiment an attempt was made to test the generality of the Guy et.al. (1966) results. The paradigm was extended to include groups with varying levels of redundancy which undergo a nonreversal shift prior to task solution. A similar use of a nonreversal shift prior to task solution was used by Bower & Trabasso (1963, 1964) in a series of experiments to test incremental versus all-or-none theories of concept learning. It was hypothesized that if there is no incremental build up of associations prior to the trial of last error, the occurrence of a reversal or nonreversal shift either after an error on the fifth or tenth trial or after every second error, should not impede learning after the shift. The results were consistent with the predictions of an all-or-none theory of learning. Presolution data showed stationarity of responding. No significant increases in error rate or in the number of trials to solution occurred in the groups who underwent a shift. If incomplete learning has no effect on postshift learning then the various percentages of redundancy prior to solution should have no differential effects on postshift learning.

More recent experimentation shows the importance of memory in concept learning. The deleterious effects of misinformative feedback (Erickson, 1968) and random reinforcement (Levine, 1962) support the hypothesis that some information concerning which strategies are wrong and which are yet possible correct, is retained in short-term memory.

This memory factor is a possible explanation for the decrement in postshift learning found by Guy et.al. (1966). In the cases of 50% and 75% redundancy, misinformation with respect to the postshift solution is being given to the subject. If this information is retained in the memory it can have a deleterious effect on the postshift learning. Thus misinformation can explain the interference which occurs in postshift performance. This same interference would then be expected in groups which undergo the shift prior to solution as well as in those groups which receive a postsolution shift.

Analysis of the preceding studies suggest the following predictions. An all-or-none approach to learning would predict that the sequence of redundant stimuli prior to the precriterion nonreversal shift would have no effect on postshift learning. It would also predict no differential effect of various percentages of redundancy in the presolution nonreversal shift groups. However, when the memory factor is taken into account, one would predict the misinformative feedback, given prior to the shift with respect to the postshift relevant dimension, would lead to a retardation of the postshift learning.

Since there are more misinformative feedback trials given to the 50% redundant groups than to the 75% redundant groups, it was hypothesized that the decrement in postshift learning would be more severe for the 50% groups than for the 75% groups. If the subjects in the 100% groups learn about both dimensions they do not receive misinformation. Consequently, their postshift learning should be less retarded. When the differential effects of percentage of redundancy are interpreted in terms of misinformative feedback these results seem to be consistent with hypothesis testing theories of concept identification.

It was also predicted that there would be an effect of percentage of redundancy on original task learning for subjects who solve prior to the shift. While increasing the percentage of redundancy should facilitate learning, it was predicted that learning would be optimal in the 75% redundant groups where the correlation is high enough to facilitate learning but the nonredundant trials enable the subject to reject the redundant dimension and solve on the relevant dimension.

METHOD

Design

The present experiment consisted of a 2 (level of preshift learning) x 3 (percentage redundancy) x 2 (problem) x 2 (response assignment labeling) factorial design. Each of these variables will now be discussed in greater detail.

Two levels of learning prior to a nonreversal shift were studied: first, the complete solution of a concept identification task prior to the addition of a redundant dimension and subsequent nonreversal shift to that dimension; and second, the incomplete solution before a nonreversal shift in a task in which the to-be-relevant dimension has been redundant with the relevant dimension from the beginning of the task. These constitute the postsolution nonreversal shift and presolution nonreversal shift conditions which are referred to as Treatment A and Treatment B, respectively.

The second variable, as stated above consisted of introducing one of three levels of percentage of redundancy, 50%, 75% or 100%, during the last eight reinforced trials just prior to the nonreversal shift. The third variable in the design was that of problem, defined as the dimension which was relevant prior to the nonreversal shift. The two problems used in this experiment had position (Problem 1) and number (Problem 2) as preshift relevant dimensions. This variable was introduced to decrease the possibility that the results would be affected due to communication between subjects. The fourth variable in the design was that of response assignment labeling. This refers to the choice of which values of a dimension are labeled with which response assignment, 'A' or 'B'. This last variable was introduced as a balancing technique because subjects frequently have a tendency to begin by labeling the first card as 'A'.

<u>Treatment A</u> - The postsolution nonreversal shift conditions consisted of the following three stages:

<u>Stage 1</u> - All subjects in this treatment were required to solve a simple concept identification task involving one relevant and four irrelevant dimensions, to a criterion of ten consecutive correct responses. The five binary dimensions used were form, number, size, color and position; with either position (Problem 1) or number (Problem 2) relevant.

<u>Stage 2</u> - Stage 2 consisted of a total of ten trials, eight reinforced and two blank trials. A sixth and novel dimension (background) was introduced in this stage and made redundant with the dimension that the subject had solved on by the end of Stage 1. This stimulus redundancy was at one of the three percentages, 50%, 75% or 100%, and defined as the percentage of time the two dimensions covary.

<u>Stage 3</u> - At the beginning of this stage, which involved all six binary dimensions, a nonreversal shift to the redundant stimulus dimension occurred.

<u>Treatment B</u> - The presolution nonreversal shift conditions consisted of the following two stages:

<u>Stage 1</u> - In this first stage the subject was presented with stimuli varying on all six binary dimensions for a total of ten trials, eight reinforced and two blank trials. During this stage the dimension of background was redundant with the relevant dimension at one of the three percentages. As in Stage 2 of

Treatment A, the relevant dimension was either position (Problem 1) or number (Problem 2). The irrelevant dimensions were the remaining four.

Stage 2 - This stage was identifical to Stage 3 of Treatment A.

The Blank Trials

The blank trials, trials with no information feedback, occurred on trials number five and ten of the redundant stages (Treatment A - Stage 2 and Treatment B - Stage 1), and were used primarily as a test for solution. These two blank trials were structured to provide hypothesis tracking. This was possible because all the dimensions except the relevant dimension kept the same values between the blank trial and the following trial.

The first blank trial was used primarily to adapt the subject to nonreinforcement so that the occurrence of the shift would not come simultaneously with the first instance of nonreinforcement. All subjects in Treatment A were expected to show solution on these tests due to the fact that they had displayed learning to a criterion during the first stage. In order to satisfy the requirements for inclusion of a subject's data in Treatment B during analysis, the subject must have been in the presolution state prior to the occurrence of the nonreversal shift. Therefore the finding of a response sequence such as correct-correct-correct or error-correct-correct occurring on the trial immediately preceding the blank trial, the blank trial, and the trial immediately following the blank trial, respectively, implied that the subject had solved and his data was excluded from the presolution shift data and analyzed in a separate group. Data from the separate group henceforth will be referred to as from Treatment C, and was used to study the effect of percentage of redundancy on the frequency of correct transfer over the blank trials. Separation of the preshift solvers from Treatment B might have caused the elimination of fast learners from this group. This problem is not unique to this study and appears to be unavoidable.

Procedure

Each subject was run individually in a half-hour session under the following conditions. The subject was seated at one side of a double desk with the experimenter seated at the other side. Between them was a white cardboard divider 12" high and 16" wide, behind which was placed the stimulus materials used during the session. Instructions were read to the subject as follows:

> "In this experiment you will be shown a series of cards one at a time. These cards can be divided into two groups - one called 'A' and one called 'B'. Your job is to figure out the basis by which the cards are sorted into groups. Everytime you see a card I want you to

> verbally label it as an 'A' or a 'B'. Just guess when you are not sure. After you respond you will be told whether you are right or wrong and a new card will be shown to you. But you cannot go back and see a card to which you have already responded even though it might reappear later. We will continue the experiment until you have demonstrated your ability to sort the cards correctly. Sometimes I won't tell you whether you are right or wrong. In this case don't be disturbed. Just continue to respond trying to be correct as often as possible. Are there any questions before we begin?" Any answerable questions were then answered, after which the experimenter said, "Here is your first card", and presented the first stimulus card to the subject.

The stimulus cards were then presented successively in a reception paradigm. In spite of the fact that the experiment is conceptually divided into two or three stages in treatment conditions B and A, respectively, it was run off as one continuous uninterrupted session for each individual subject. The subject's verbal responses were self-paced. This allowed him to view each stimulus card for as long as he wanted to before making his response. On all reinforced trials, after the subject responded he was given immediate verbal feedback from the experimenter, in the form of 'right' or 'wrong', concerning the correctness of his response. In the case of a blank trial no reinforcement was given. After a two second delay, as determined by the experimenter counting 1-2, the stimulus was removed. The experimenter then pressed a button to start the automatic timing unit operated by relay switching circuitry, which provided a constant five second intertrial interval. At the end of the intertrial interval a new stimulus card was presented to the subject and thus a new trial begun. This procedure was repeated for each trial until the experimental session was terminated.

Termination of the experiment proceded as follows. In the final stage of the experiment, that is the stage following the nonreversal shift in dimensions, all subjects who had solved and were presumably in the learned state, were run to a criterion of fifteen consecutively correct responses. If the subject had not begun his criterion run by the 80th postshift trial his experimental session was terminated on his next error.

Upon completion of the experiment the subject was asked not to relate to anyone who might be in the experiment, anything about the procedure or solution. The subject was then thanked for his time and effort in participating in the experiment and released from the experimental session.

Subjects

Female subjects from introductory psychology courses at the University of Massachusetts were participants in the present experiment. Such experimental participation is a course requirement. Thirty-six subjects were placed in the postsolution nonreversal shift groups of Treatment A. In the event that a subject failed to solve Stage 1 of Treatment A within the first eighty trials his data was excluded from the main analysis and he was replaced by another subject. It was assumed that this was sufficient time to learn the task unless the subject was nct following directions.

An unlimited number of subjects were run under the presolution nonreversal shift conditions of Treatment B until a total of thirty-six subjects had satisfied the preshift requirements for inclusion in the group. Data from subjects being run under the presolution shift conditions but who solved prior to the nonreversal shift, as determined by blank trials, were removed from the main design and analyzed as a separate group.

Each subject was randomly assigned to one of twenty-four experimental groups upon arriving for the experimental session, making a total of three subjects per cell in the experimental design.

Stimulus Materials

The stimulus materials used in this experiment consisted of geometric figures made from Trans-pak die-cut plastic symbols and placed on 4" x 6" index cards, with either a plain white background or a background of marbled black and white texture produced by a Chart-pak plastic covering. Each stimulus card took as its characteristics one of two possible values of each of six binary dimensions. The following dimensions were used: color - with values of red or blue, form - with values of triangle or circle, number - with values of one or two, position - with values of placement of figure near top or bottom of card, size - with values of large or small, and background with values of white or marbled texture.

Stimulus Sequences

Stimulus sequences for preshift training of the postsolution shift groups

Stimulus sequences in the preshift training conditions for the postsolution nonreversal shift groups of Treatment A were as follows: In Stage 1 of Treatment A, 80 stimulus cards varying in five dimensions, form, color, size, position, and number were used. These cards involved two complete sets of 32 cards and a random selection of 16 cards from a third set of 32 cards. This same randomization of 80 cards was used for one subject in each of the twelve different conditions in Treatment A. After one subject had been run under each condition a random selection was made from the incomplete subset of 16 cards selected from the third set of stimuli and a new randomization was made in such a way so that no card appeared twice before all cards within one set of 32 had an opportunity to appear once. That is, each complete 32 card set of stimuli and the 16 card subset were randomized separately. Thus the re-selection, re-randomization process described above was done a total of three times, once for each of the three subjects per cell.

Stimulus sequences in the redundant stages

Stimulus sequences in the redundant stages were as follows: Stage 1 of Treatment B and Stage 2 of Treatment A involved a variation in the percentage of redundancy of the relevant dimension and the to-be-relevant dimension. Different sequences of cards were prepared for this ten trial long redundant stage for each level of redundancy, each problem and each response assignment variation. The same sequence that was used for a subject in a cell of Treatment A was used for the subject in the corresponding cell of Treatment B.

These sequences were arranged so that during both sets of four reinforced trials - in the four reinforced trials followed by one blank trial, four reinforced trials, and one more blank trial - the to-be-relevant dimension, in all cases background, was redundant with the relevant dimension either 50%, 75% or 100% of the time. In the cases of 100% redundancy, the to-be-relevant dimension covaried perfectly with the relevant dimension. That is, every card belonging in the class labeled 'A' according to the dimension which was relevant after the nonreversal shift occurred, was given the label 'A' in accordance with the preshift relevant solution also. In cases of 50% redundancy, the to-be-relevant dimension covaried with the relevant dimension half of the time, ie., four of the eight cards belonging to the class labeled 'A' according to the preshift dimension relevancy also belonged to the class labeled 'A' according to the postsolution relevant dimension. This is equivalent to a chance or random occurrence of one binary dimension covarying with another. In the 75% redundant cases, the to-be-relevant dimension covaried with the now-relevant dimension 75% of the time, or on a total of six of the eight reinforced trials.

On both of the blank trials in this redundant stage, the redundant dimension broke off from the relevant dimension. That is, in all cases the only dimension which was changed from the blank trial to the following trial was that which was the preshift relevant dimension. This test for solution on the preshift task determined the stimulus card which would occur on the first trial of the nonreversal shift stage.

<u>Stimulus sequences in the nonreversal shift stages</u>

Stimulus sequences in the nonreversal shift stages involved a total of 95 cards with 64 unique stimuli being used. Randomization procedure was the same as for Stage 1 of Treatment A.

RESULTS

<u>Analysis of transfer in the nonreversal shift stages</u>

An analysis of variance using the number of total errors accumulated during the nonreversal shift stage as the dependent variable was performed on the data from subjects in the presolution and postsolution shift groups of Treatments A and B. Table 1 shows that there was a significant difference in the main effects of level of preshift learning, $F(1,48) = 6.71$, $p < .025$; and percentage redundancy, $F(2,48) = 5.40$, $p < .01$; and in the second order interaction of level of preshift learning × percentage redundancy × problem, $F(2,48) = 5.15$, $p < .01$.

An analysis of variance on the same data using the trial of last error in the nonreversal shift stage as the dependent variable showed essentially the same results.

The results, as diagrammed in Figure 1, showed that postshift learning was more difficult for those subjects who underwent a nonreversal shift after they had completely solved a prior task. The percentage of redundancy during the ten trial stage immediately prior to the occurrence of the shift also significantly affected postshift learning with learning being less difficult for the 100% redundancy groups (refer to Figure 2). Figure 3 shows that this is true for both the postsolution and presolution shift groups.

A Scheffé simple effects test on the redundancy variable using total errors as the dependent variable has shown no significant difference between the levels of 75% and 50% redundancy, while there was a significant difference between the 100% redundancy groups and the average of the 50% and 75%

redundancy groups, $F(1,48) = 5.39$, $p < .05$. Therefore all the variability due to redundancy can be accounted for by the level of 100% redundancy.

Figure 4, diagramming the interaction between level of preshift learning, percentage redundancy, and problem, shows that the mean total errors during the nonreversal shift stage decreased with increases in percentage redundancy for the postsolution group which solved on Problem 2 (number) and presolution group which solved on Problem 1 (position). However, for the postsolution shift group solving Problem 1 and presolution group solving Problem 2, there was a maximum number of mean total errors during the nonreversal shift stage occurring at the level of 75% redundancy. There was no significant effect of problem or response assignment labeling.

Analysis of frequency of correct transfer over blank trials on preshift data

The Chi-square analysis performed on the presolution shift subjects of Treatments B and C showed that the frequency of correct transfer over the blank trials at the end of the redundant stage was significantly related to the level of redundancy occurring between the variables, $X^2 = 7.123$, d.f. = 2, $p < .05$. The results of a partitioning of the contingency table into independent additive components, as used by Castellan (1965), are presented in Table 2. The comparison of the 100% redundancy versus 50% redundancy groups was found to be nonsignificant, $X^2 = 1.690$, d.f. = 1, $p<.10$; while a comparison between the 75% redundancy groups and the average of the 100% and 50% redundancy groups was found to be significant, $X^2 = 5.60$, d.f. = 1, $p<.02$. These results show that manipulating the percentage of redundancy between variables has an effect on learning an original task. Furthermore, a redundancy level of 75% is found to optimize the probability of transfering correctly over the blank trials. As Figure 5 shows, this results in an inverted-U shaped function relating percentage redundancy to proportion of correct transfers rather than the expected monotonic linear function.

DISCUSSION

The results of this study show that there is a significant difference in postshift learning depending on whether the subject was shifted prior to or after he learned an original task. Learning of the second task was found to be more difficult for the subjects who had solved the initial task and completed a criterion run.

The results also indicate that learning of the nonreversal shift was affected by the level of redundancy occurring during the intermediate stage. This redundancy variable was found to affect postsolution shift learning groups and presolution shift learning groups in a similar way. Guy et.al. (1966) found that increasing the percentage redundancy in an intermediate stage tends to facilitate postshift learning. While these results show that this finding can be generalized to include a presolution nonreversal shift condition the two studies differ in an important result. The Guy et.al. (1966) study found the 100% redundant groups to perform better than the 75% redundant groups; and the 75% redundant groups to perform better than the 50% redundant groups in postshift learning. The present study has shown no significant difference between the 75% and 50% redundant groups.

There was no control group used to determine whether the presolution shift subjects learned the nonreversal shift task any differently than subjects who learned a six dimensional task with no intermediate redundant stage. Such a group would not undergo a nonreversal shift and differences in warm-up effects and exposure made the use of such a group untenable. However, the finding that varying redundancy affected the nonreversal shift learning similarly in the presolution groups and in the postsolution groups implies a similar process could be occurring irrespective of level of preshift learning.

The finding of an effect of percentage redundancy on learning in the presolution shift groups lends some support to the all-or-none view of concept learning. Such a theory asserts that the occurrence of trials with levels of 50% or 75% redundancy prior to the subject's solution of the task and prior to a shift in solutions should have no effect on subsequent postshift learning. However, in the 100% redundancy groups the subject could solve on the relevant dimension, the redundant dimension or both. Solution on the redundant dimension or both dimensions simultaneously would produce postshift learning superior to that of the partial redundancy groups.

This effect of redundancy on postshift learning is explainable in terms of misinformation. Varying the amount of redundancy necessarily implies varying the amount of misinformation. This information is given with respect to the postshift relevant dimension. If such information is retained in the subject's short-term memory, as has been found by Levine (1962), Holstein & Premack (1965), and Merryman, Kaufmann, Brown & Dames (1968), it can have a deleterious effect on postshift learning. This decrement in learning could be caused by an increase in the size of the hypothesis set and thus cause a decrease in the probability that the particular hypothesis be sampled, as hypothesized by Holstein & Premack (1965), or by a more active ignoring of the dimension called cue neutralization by Levine (1962).

Thus the finding that subjects in the 75% and 50% redundant groups do significantly worse in postshift learning than subjects in the 100% redundant groups can be explained by the fact that these subjects in the partially redundant groups are receiving misinformation with respect to the to-be-relevant dimension while subjects in the 100% redundant groups are not.

Mathematical models of concept learning which take memory into account, such as the Consistency Check model of Trabasso & Bower (1966) and the Hypothesis Manipulation model of Chumbley (in press), could be applied to test these factors. Explaining such results in terms of misinformation and memory makes such findings consistent with hypothesis testing theories of concept identification rather than inconsistent with such as claimed by Guy et.al. (1966).

The finding that preshift learning is optimal in the groups receiving a level of 75% redundancy between dimensions is of interest. This learning was measured by correct transfer over the blank trials prior to the occurrence of the nonreversal shift. It appears that in the 75% redundant groups the correlation between dimensions is high enough to facilitate learning but the occurrence of the nonredundant trials enables the subject to reject the redundant dimension and therefore solve on the relevant dimension.

A number of hypotheses could explain this finding. Consistent with Bourne & Haygood (1960) is the hypothesis that increasing the level of redundancy from 50% to 75% would facilitate learning due to the fact that you are decreasing the effect of irrelevant dimensions. Following this line of reasoning the 100% redundant groups theoretically should perform at a level superior to the 75% redundant groups. However, in the present experiment the subject, even though he might have been aware that he could solve on either the relevant or redundant dimension or both simultaneously, was forced to choose one of these on the blank trials. To be included in Treatment C he necessarily must have chosen the relevant dimension. However, a subject might be aware of the two simultaneous solutions and choose the redundant dimension; thus placing himself in Treatment B.

A second hypothesis which can explain the above results is that increasing the percentage redundancy above the chance or 50% level to a level of 75% redundancy would increase in degree of stimulus emphasis, thus making the relevant dimension more noticeable. Trabasso (1963) successfully directed the subject's attention and emphasized the dimension relevant to solution by either (1) eliminating irrelevant dimensions, (2) increasing the differences between the attributes of the relevant dimension or (3) using a color contrast to emphasize the relevant dimension. To obtain stimulus emphasis using these techniques Trabasso found it important that no alternative solutions be present during training.

The present experiment provides an additional method of stimulus emphasis; by increasing redundancy between dimensions above a chance level. The occurrence of a level of 100% redundancy between dimensions provides an alternative solution and thus decreases or interferes with stimulus emphasis.

TABLE 1

ANALYSIS OF VARIANCE FOR TREATMENTS A AND B USING TOTAL ERRORS IN NONREVERSAL SHIFT STAGE AS DEPENDENT VARIABLE

SOURCE[a]	DEGREES OF FREEDOM	MEAN SQUARES	F	p
1. TOTAL	72	20503.13		
2. A	1	1258.35	6.708	*p<.025
3. B	2	1012.50	5.398	**p<.01
4. C	1	703.13	3.748	n.s.
5. D	1	15.13	.081	n.s.
6. AB	2	47.39	.253	n.s.
7. AC	1	284.01	1.514	n.s.
8. BC	2	118.17	.630	n.s.
9. AD	1	6.13	.033	n.s.
10. BD	2	267.17	1.424	n.s.
11. CD	1	100.35	.535	n.s.
12. ABC	2	966.72	5.153	**p<.01
13. ABD	2	113.17	.603	n.s.
14. ACD	1	300.13	1.600	n.s.
15. BCD	2	62.05	.331	n.s.
16. ABCD	2	327.17	1.744	n.s.
17. S(ABCD)	48	187.58		

[a] A = level of preshift learning
B = percentage redundancy
C = problem
D = response assignment labeling

TABLE 2

PARTITIONING OF X^2 CONTINGENCY TABLE
TREATMENTS B AND C

Source	Degrees of Freedom	X^2	p
100% redundancy versus 50% redundancy	1	1.69	n.s.
(100% + 50%) redundancy versus 75% redundancy	1	5.60	$p < .02$
total	2	7.29	$p < .05$

FIGURE 1

MEAN TOTAL ERRORS DURING NONREVERSAL SHIFT STAGE
FOR POSTSOLUTION AND PRESOLUTION SHIFT SUBJECTS
TREATMENTS A AND B

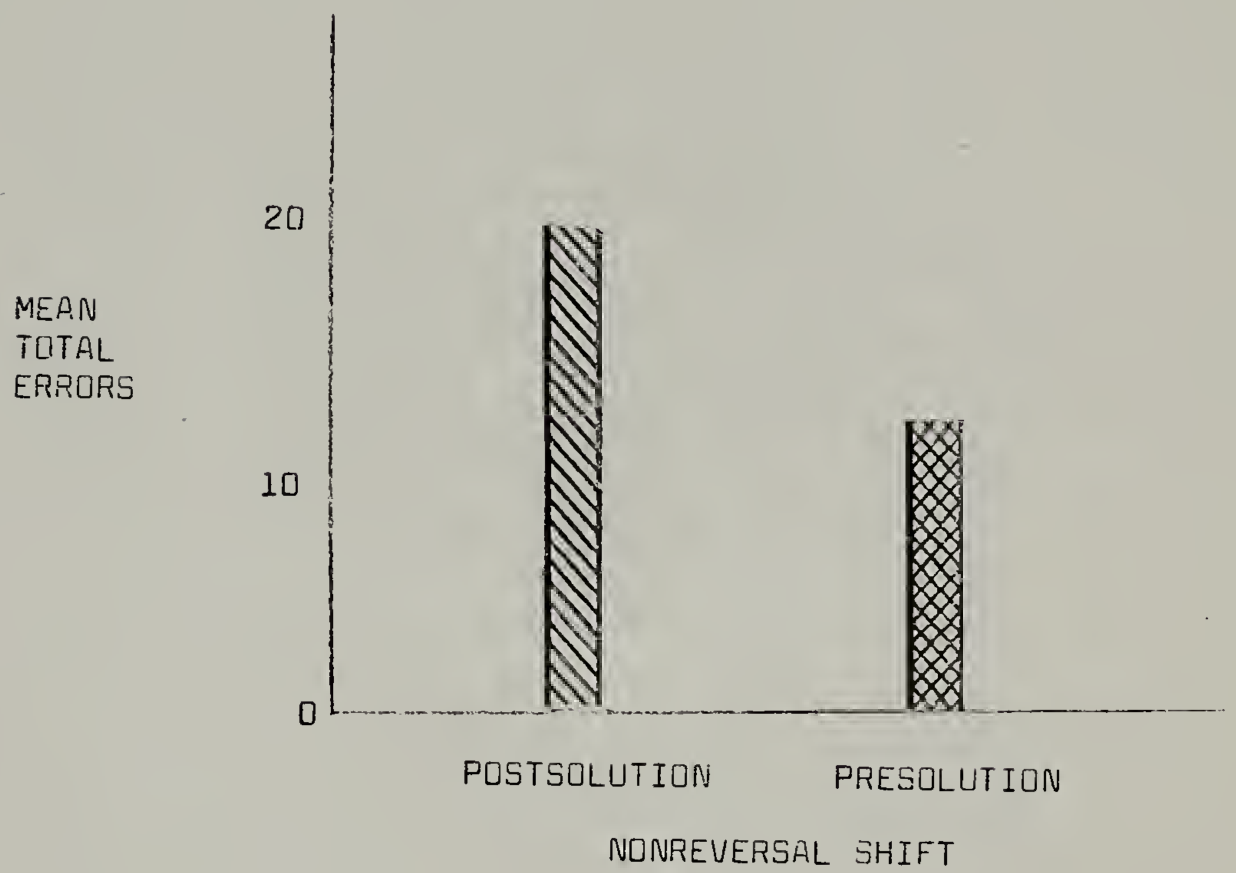


FIGURE 2

MEAN TOTAL ERRORS DURING NONREVERSAL SHIFT STAGE FOR LEVELS OF PERCENTAGE REDUNDANCY TREATMENTS A AND B

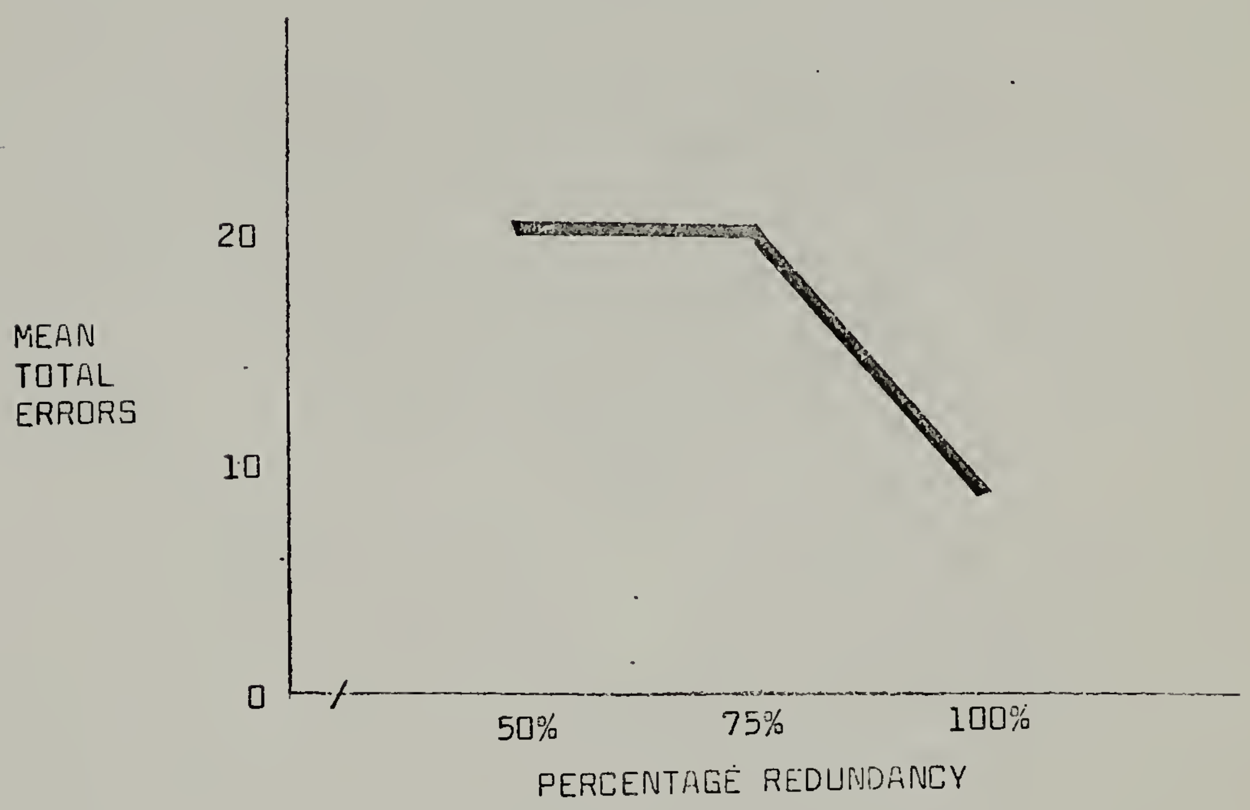


FIGURE 3

MEAN TOTAL ERRORS DURING NONREVERSAL SHIFT STAGE FOR LEVELS OF PERCENTAGE REDUNDANCY FOR PRESOLUTION AND POSTSOLUTION SHIFT GROUPS TREATMENTS A AND B

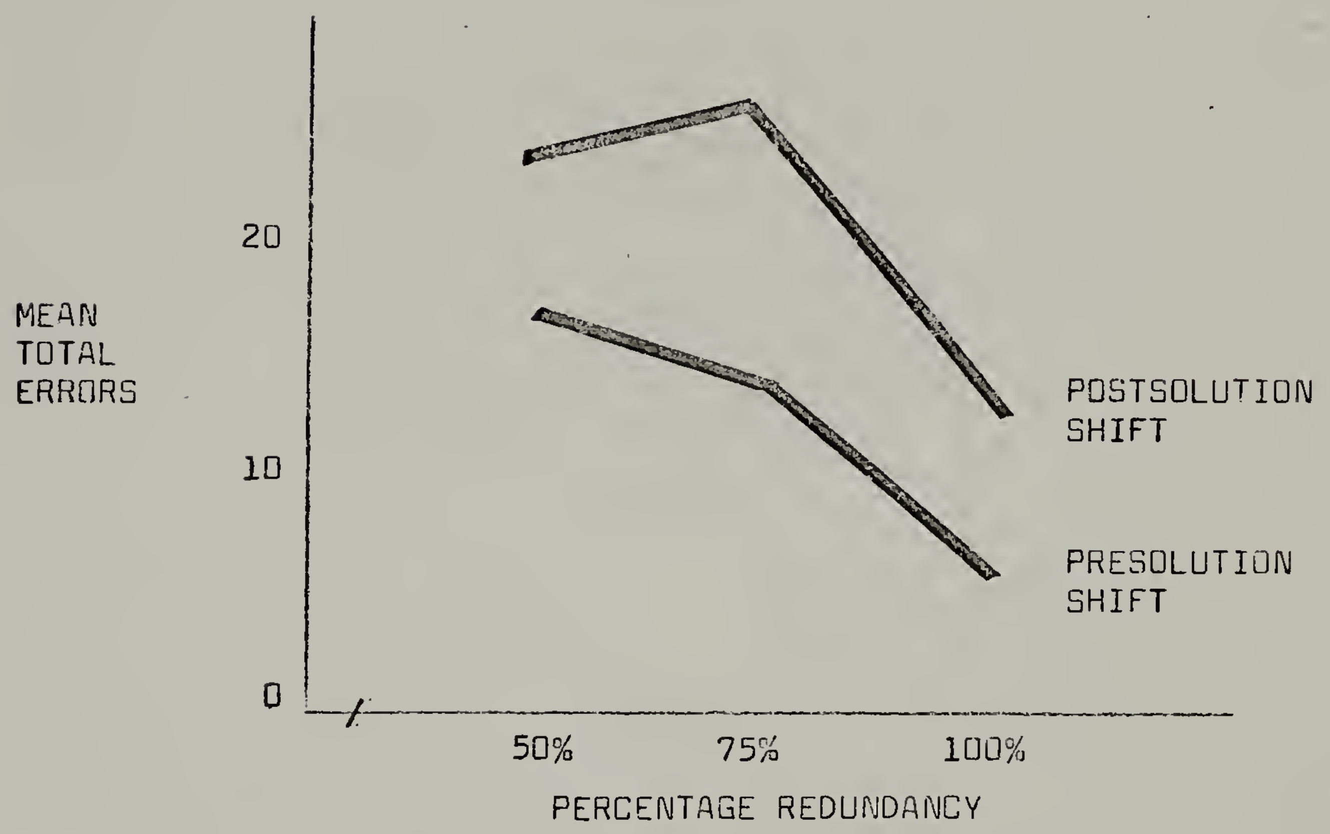


FIGURE 4

MEAN TOTAL ERRORS DURING NONREVERSAL SHIFT STAGE FOR SECOND ORDER INTERACTION OF LEVEL OF PRESHIFT LEARNING x PERCENTAGE REDUNDANCY x PROBLEM TREATMENTS A AND B

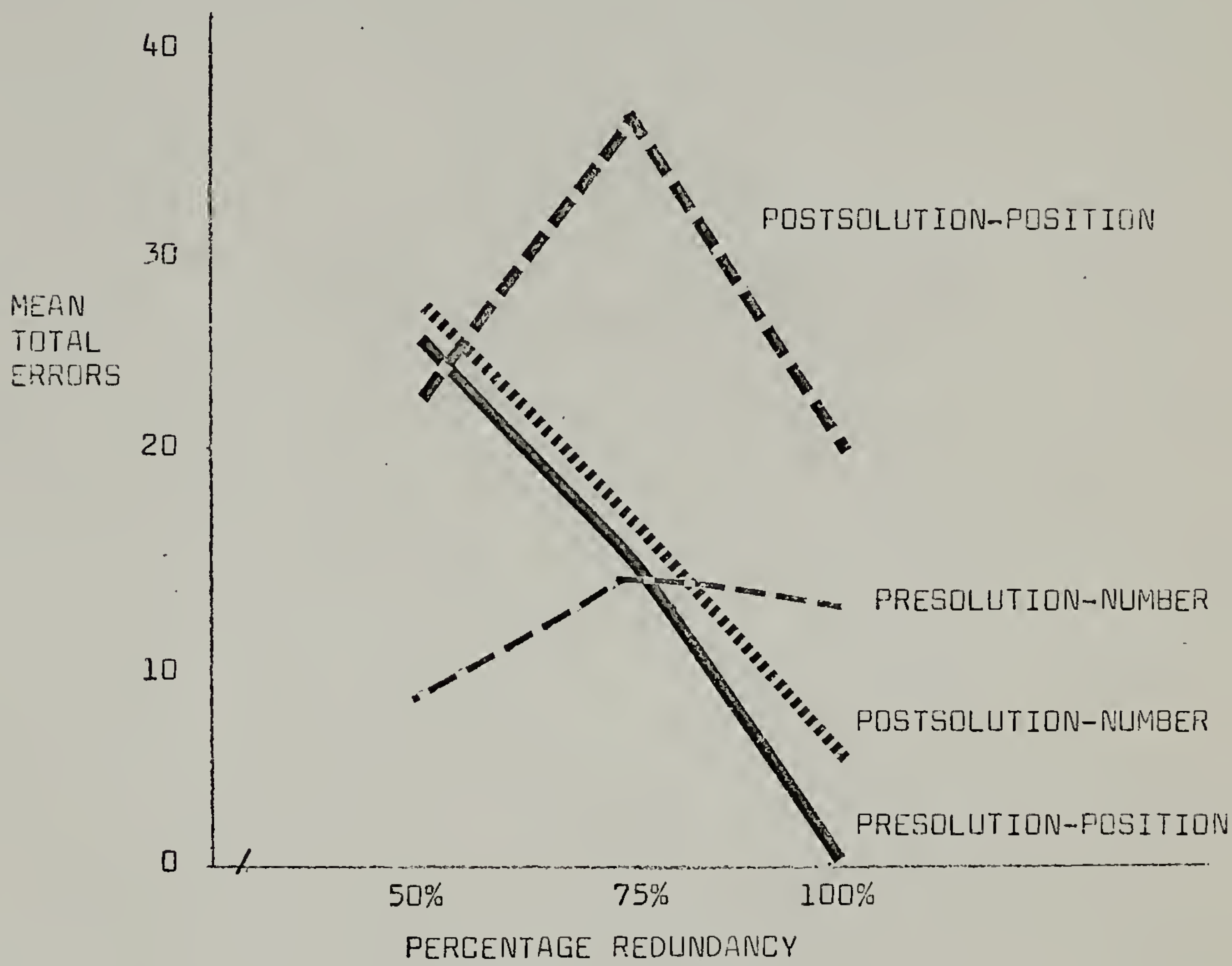
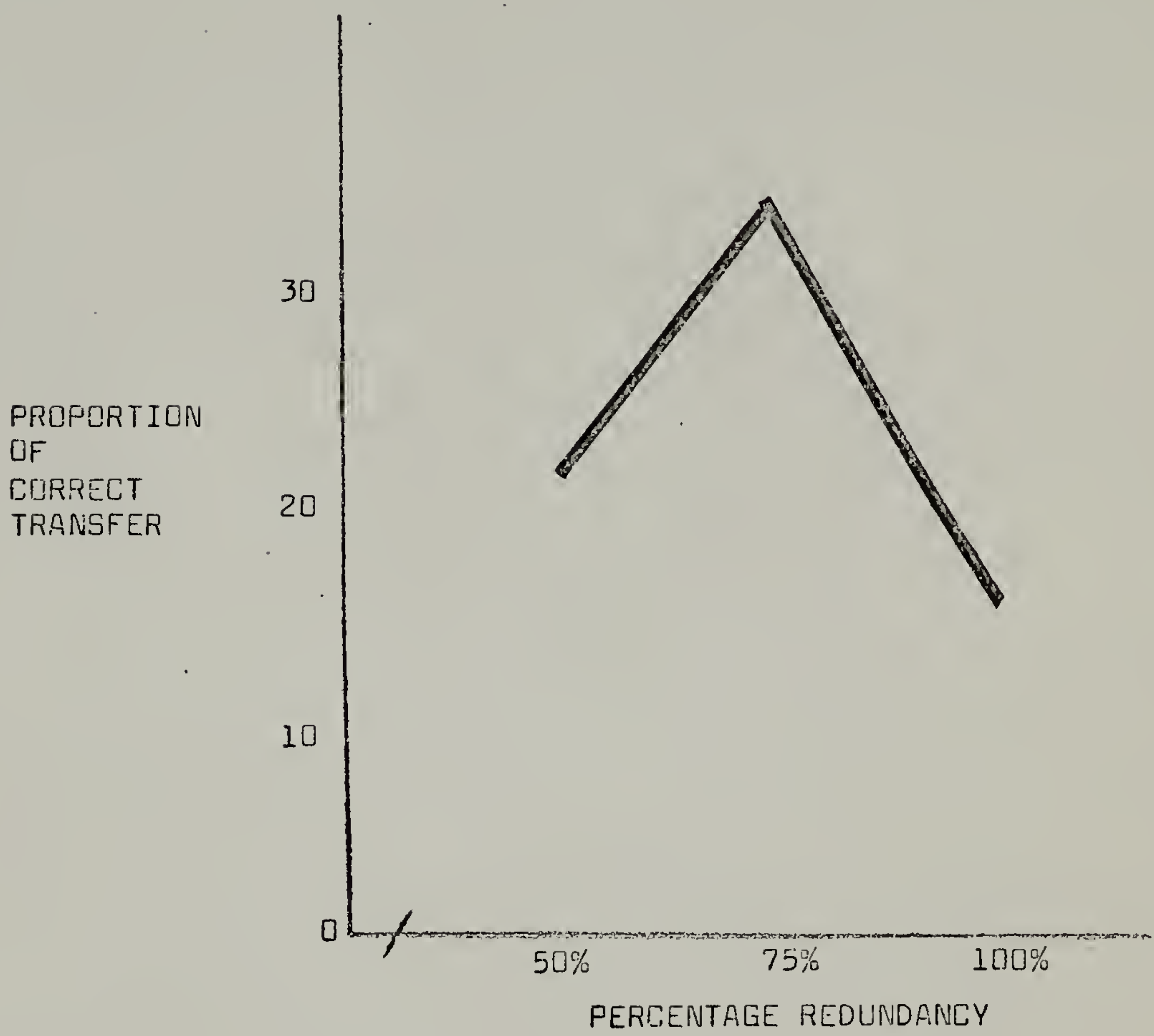


FIGURE 5

PROPORTION OF CORRECT TRANSFER OVER BLANK TRIALS IMMEDIATELY PRIOR TO NONREVERSAL SHIFT TREATMENTS B AND C



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APPENDIX

Cell Means

	Postsolution		Presolution		
Percentage Redundancy	Problem Position	Problem Number	Problem Position	Problem Number	$\bar{X}$ red.
50%	22.33	26.00	25.67	8.50	20.63
75%	36.00	16.83	15.67	14.00	20.63
100%	20.17	5.00	0.17	12.17	9.38
	$\bar{X}_{post}$ =	21.05	$\bar{X}_{pre}$ =	12.69	